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EDITORIAL

Rob Hughes, *Editor*

This issue of the journal marks the appearance of a new Editorial Advisory Board. Its membership represents a carefully considered combination of distinction and experience in comparative psychology while also retaining the journal's international quality in relation to regions of the world where our discipline and Society feature prominently. All members of the new Board are committed to publicizing and promoting the interests of the journal as well as acting as reviewers and, when appropriate, Action Editors of submitted manuscripts. The Operations Committee of the Society and the Editors believe that the new Board, along with administrative changes designed to reduce delays between submission and publication, will significantly improve the quality, popularity and impact of the journal. It is therefore hoped that members of the International Society for Comparative Psychology and previous authors will make this journal their first choice as an outlet for their work and encourage their colleagues and students to do likewise.

HABITUATION TO HUMAN BEINGS VIA VISUAL CONTACT IN DOCILE AND FLIGHTY STRAINS OF DOMESTIC CHICKS

R. Bryan Jones
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ABSTRACT: The present study examined the effects of two treatments on the approach / avoidance responses of pair-housed female domestic chicks of a Ross broiler and two laying strains (one docile ISA Brown medium hybrid, one flighty White Leghorn light hybrid) to a visible experimenter. Chicks in the visual contact (VC) group were allowed to see the experimenter for 30 s twice a day from 1 day of age until testing at 10 or 11 days whereas controls (CON) received minimal human exposure throughout the study. Apart from the visible presence of the experimenter, treatment procedures were similar for the two groups. All chicks were tested individually but pair means were used as data points. Chicks of all three strains which had received the VC treatment showed considerably lower avoidance of humans than did their CON counterparts. The present results demonstrate that fear of humans was markedly reduced by a simple regime of close visual contact with the experimenter, presumably through habituation, and that this effect was common to chicks of flighty as well as docile strains. These findings are discussed in terms of their implications for resource management in the laboratory and on the farm.

INTRODUCTION

Fear of human beings and its reduction through some method of habituation have important implications for the housing and husbandry of domestic chicks in the laboratory and on the farm. Firstly, the outcome of experiments may be influenced by differences across or within laboratories in the degree and/or nature of animal-human contact and, thereby, in the likelihood that habituation to people might occur. For instance, it was shown that differences between genetic lines of chickens in their immune responses to challenge were accentuated in those chicks which had been habituated to the

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experimenters through a regime of regular handling (Gross & Siegel, 1979). It has also been suggested that the socialization (sic) or habituation of domestic chicks to humans might compromise the ecological validity of experimental studies in which the birds are reared in isolation (Eddy & Gallup, 1994). Secondly, intense or persistent fear of human beings can severely harm the welfare, management and performance of poultry. Indeed, heightened fear of humans has been associated with numerous adverse effects in layer and in meat-type broiler chickens. These include i) increased risk of injury, pain, and death caused by inappropriate fear responses, such as panic and violent escape, ii) greater feather loss and the consequent increases in heat loss and in susceptibility to injury, iii) increased aggressiveness, and iv) reductions in growth, food conversion efficiency, egg production and eggshell quality with the associated economic loss (Barnett, Hemsworth, & Newman, 1992; Craig, Craig, & Dayton, 1983; Hemsworth & Barnett 1989; Jones 1989; 1995; Jones, Hemsworth, & Barnett, 1993; Jones & Hughes, 1986; Komai & Guhl, 1960; Mills & Faure, 1990).

The domestic chick's fear of humans can be reliably and powerfully reduced through a regime of regular gentle handling, presumably through a process of habituation (Gilman, Marcuse, & Moore, 1950; Jones & Faure, 1981; Jones & Waddington, 1992, 1993). Chicks habituated to one particular handler also showed reduced fear of other quite dissimilar people, regardless of variations in their gender or in the colour and style of their clothing (Jones, 1994). This treatment also facilitated later capture and handling (Gross & Siegel, 1982), decreased aggressiveness within the flock (Collins & Siegel, 1987), and improved FCE and growth in young broiler and layer chicks (Gross & Siegel, 1982; Jones & Hughes, 1981; Thompson 1976). However, the regular handling procedure traditionally involves picking the chick up for brief periods, stroking it gently, talking to it and perhaps offering it food and, despite their clear potential benefits, it would simply not be feasible to apply such handling regimes in today's huge commercial flocks. Encouragingly though, a recent study demonstrated that fear and avoidance of humans was reduced in pair-housed chicks of a medium hybrid layer strain (ISA Brown) simply by allowing them to see the experimenter for 30 s twice daily (Jones, 1993); in fact, this "visual contact" procedure was even more effective than a regime of gentle handling. Similarly, Eddy and Gallup (1994) found that passive socialization to human beings developed solely through regular visual contact reduced subsequent fear of people in individually-housed Production-Red

chicks. These observations are important because effective modification of the human / chicken relationship through mere visual contact with people might have practical relevance.

Pronounced strain differences in the chicken's behavioural and physiological responsiveness to human beings have been reported, with light-hybrid White Leghorns generally showing substantially greater fear and avoidance than medium hybrid birds (Gallup, Ledbetter, & Maser, 1976; Jones, Hughes, & Duncan, 1981; Jones & Mills, 1983; Murphy & Duncan, 1977). Similarly, despite the absence of objective evidence, meat-type broiler chickens are commonly considered to be more docile than light- or medium-hybrid layers (Siegel, 1983; Appleby, Hughes, & Elson, 1992). Before we can properly assess the overall applicability of the visual contact (VC) procedure, we must ask whether its effects will generalize across chickens of a number of strains which differ in their presumed levels of flightiness / placidity. Therefore, the present study compared the degree of avoidance of the experimenter shown by individually-tested, pair-housed chicks of a medium hybrid ISA Brown, a light hybrid White Leghorn, and a Ross broiler strain which had either received regular visual contact with the experimenter or minimal exposure to people.

Fear responses in the domestic chick are thought to increase in frequency and intensity from very low levels on day 1, through a series of peaks and troughs, to high levels by 9 or 10 days of age when overall bias to right hemisphere control develops (Salzen, 1979; Andrew & Brennan, 1983; 1984). Therefore, all the chicks were tested at 10 or 11 days in the present study in order to avoid the potentially confounding effects of these early fluctuations in fear.

Ideally, fear is an adaptive emotional response to perceived danger with fear behaviour, such as withdrawal, functioning to protect the animal from injury (Jones, 1987; Toates, 1980). Consequently, it has been proposed that the degree of avoidance of a stimulus is a useful measure of the animal's fear of it (Hemsworth, Barnett, & Coleman, 1993). Therefore, fear of humans was functionally measured here in terms of the chicks' approach / avoidance responses to a visible experimenter in a standard test situation, under the assumption that the degree of avoidance would be positively related to the chicks' fear of humans. Indeed, avoidance scores recorded in a similar 'Box plus Experimenter' test are known to be reduced by regular handling and to be significantly correlated with fear scores assigned in other tests (Jones & Waddington, 1992; Jones, 1993).

METHOD

Animals, housing and treatments

Three single-strain batches of one-day-old female chicks were obtained at intervals of two weeks. It was only possible to house and test one strain at a time. These batches comprised firstly, 80 ISA Brown (a medium-hybrid strain originally derived from a Rhode Island White x Rhode Island Red cross), secondly, 80 Ross broiler and, thirdly, 72 White Leghorn chicks. The ISA Brown and Ross chicks were purchased from commercial suppliers whereas the White Leghorns were obtained from a flock maintained on site. Upon receipt, the chicks were housed in pairs in wooden boxes divided into two compartments each measuring 38 x 33 x 30 cm (length x breadth x height). The boxes rested on 1 m high wooden shelves and their wire-mesh floors were raised 2 cm off the shelving in order to allow passage of excreta. One wall of each compartment consisted of wire mesh whereas the other three walls were constructed of wood. Hardboard covers were placed over the wire walls. These were attached with velcro and they were only removed during treatment. Thus, the covers effectively precluded viewing of the external environment at all times other than during treatment. Wire mesh lids prevented the chicks from jumping out. Food (chick starter mash) and water were provided *ad libitum* in semi-circular plastic hoppers which were attached to grids suspended from the tops of the compartment walls. These could be removed and replaced remotely for maintenance purposes without permitting the chicks to see the attendant. An ambient temperature of approximately 29°C was maintained by a combination of convector and dull emitter heaters. The photoperiod ran from 0500 to 1900 h.

Each pair of chicks was assigned at random to one of two treatments and both treatments were represented in each box. Treatments were applied to only one pair of chicks, i.e., one compartment, at a time. Chicks from the minimal exposure or control (CON) treatment group received no deliberate visual or physical contact with human beings other than that incurred during initial placement in the home cage and upon their removal at test. The hardboard covers were removed from the wire-mesh wall of their home compartment twice a day for 30 s but the experimenter stood to one side and out of the birds' sight. Thus CON chicks could only see the dun coloured wall and the wooden walls of the boxes situated

directly across the aisle during treatment. Conversely, when the hardboard cover was removed, the experimenter stood directly in front of and gently stroked the wire-mesh wall of the home compartment of each pair of chicks in the VC group for 30 s twice daily. The experimenter stooped during this procedure so that his face was level with and approximately 25 cm away from the wire wall. The experimenter's eye movements and direction of gaze were random apart from the proviso that, since eyes and eye shapes are aversive to young chicks (Jones, 1980), he avoided staring at the birds for periods longer than 2 or 3 s. The chicks remained otherwise undisturbed until their responses in the Box plus Experimenter test were recorded at 10 or 11 days of age.

Box plus experimenter test

Each member of each pair of chicks was tested individually and once only. It was removed from its home box and carried approximately 5 m by hand to a separate room where it was placed in a rectangular box (62 x 40 x 30 cm) with three wooden walls and one of 1.5 cm wire mesh. A wire mesh lid prevented escape and the floor was covered with wood shavings. Placement of the chick in the test box was constant, it always straddled zones 2 and 3 (see below) and faced the wire-mesh wall. The experimenter remained clearly visible to the chick throughout the test. He sat directly in front of and facing the wire-mesh wall so that his head and torso were level with and approximately 30 cm away from the front of the test box. He remained silent and still, apart from those movements required to record the chick's responses, during the test. The box was divided by imaginary lines into four zones (15 x 40 cm) and the chick's position was recorded every 15 s over the 4 min test period. It scored 1 if it was in the zone closest to the experimenter and the score progressed through 2 and 3 to 4 at the far end. The total avoidance score recorded by each chick was the sum of 16 scans (minimum score = 16, maximum = 64) and high scores reflected high avoidance / fear. All chicks were tested by the same experimenter. Droppings were removed after each trial and the wood shavings were changed at regular intervals.

One member of each pair of chicks was tested at 10 days of age whereas their companions were tested when they were 11 days old. The order of testing was randomized within these blocks. The 24 h interval allowed between testing the members of each pair was considered likely to minimize any separation distress which may have

been induced by the temporary removal of the first chick (Jones & Williams, 1992). Twenty VC and 20 CON pairs of ISA Brown chicks were tested in the first experiment, 20 VC and 20 CON pairs of broilers in the second, and 18 VC and 18 CON pairs of White Leghorns in the third.

Statistical analyses

The avoidance scores recorded for each member of a pair were summed and then halved to give a single value for each pair. The resultant pair means were then used as data points throughout the study. The avoidance scores of VC and CON chicks were compared within strains using the Mann-Whitney U test (two-tailed). The intervals between receipt of chicks of each of the three strains and the differences in the nature and duration of transit between hatch and receipt precluded direct comparisons of strain effects.

RESULTS

Chicks of each of the ISA Brown, broiler, and White Leghorn strains which had received regular visual contact with the experimenter (VC) showed considerably less avoidance of the experimenter at test than did those from the corresponding minimal exposure control (CON) groups (Table 1).

Table 1. Avoidance scores in the Box plus Experimenter test of chicks of an ISA Brown medium hybrid, a broiler, and a White Leghorn light hybrid strain which had received either minimal exposure to human beings (CON) or regular visual contact (VC) with the experimenter, (means and their standard errors).

Strain	Treatment groups		Test statistic	<i>p</i>
	VC	CON		
Isa Brown (n = 20)	24.6 + 0.8	41.9 + 1.4	<i>z</i> = 5.55	< 0.0000
Broiler (n = 20)	26.4 + 1.3	45.2 + 1.4	<i>z</i> = 5.53	< 0.0000
White Leghorn (n = 18)	46.3 + 0.6	59.2 + 1.2	<i>U</i> = 11.50	< 0.002

DISCUSSION

The present findings confirmed previous observations that fear of human beings was considerably reduced in pair-housed (Jones, 1993) and individually-reared (Eddy & Gallup, 1994) medium-hybrid chicks simply by allowing them to see the experimenter for brief periods on a regular basis. Furthermore, the avoidance scores of the VC medium-hybrid ISA Browns recorded here (24.6) were remarkably similar to those (24.4) obtained in an earlier study (Jones, 1993). The present findings also demonstrated that the fear-reducing effects of this visual contact treatment generalized to include broiler chicks, which are commonly regarded, rightly or wrongly, as docile birds (Siegel, 1983; Appleby, Hughes & Elson, 1992), as well as those of a "flighty" White Leghorn laying strain. Collectively, these findings further attest to the flexibility of the handling phenomenon and they are considered likely to have important implications for the management of domestic chicks in the laboratory and on the farm.

For example, regardless of the behavioural concept or variable under investigation, a high proportion of laboratory test situations involve at least some contact between the animal and the experimenter. In view of the present findings, I would make two recommendations. Firstly, the amount and nature of human contact experienced by the test animal during routine husbandry should always be specified. Secondly, unless habituation to humans *per se* is under investigation, there should be uniformity of human-animal contact within studies. Furthermore, because fear competes with and inhibits behaviours generated by all other motivational systems (Gray, 1987; Jones, 1987), a simple regime of habituation to humans could reduce the likelihood that fear of the experimenter might interfere with the animal's performance at test. In this context, it is interesting to note that rats and mice which had received additional stimulation, including handling, in infancy showed superior learning later in life (Denenberg, 1962).

Although chicks kept in practice are likely to receive some visual contact with the farmer, the present findings also suggest that more frequent examination of the birds by the stockperson could not only improve monitoring of flock health and systems operation but that it could further facilitate habituation to humans and thereby help to reduce the chickens' fear of people. This proposal is entirely consistent with a recent recommendation made by the U.K.'s Farm Animal Welfare Council (1992) that stockpersons should systematically inspect their flocks for sick or dead birds twice a day

and that they should walk within approximately 3 metres of every bird. Furthermore, anecdotal reports suggested that flightiness was reduced and that harvesting of broilers was facilitated at certain commercial concerns in New Zealand if the stockpersons had walked regularly and noisily through the poultry sheds (Jones, 1985; 1989). Because, the stockpersons' behaviour and attitude towards the animals in their care can profoundly affect responsiveness to humans as well as performance in pigs and poultry (Hemsworth, Coleman, & Barnett, 1994; Jones 1992), these potentially influential variables must also be taken into account in any programme designed to modify fear of humans. Indeed, the nature of those human behaviours most likely to reduce fear on farm needs to be determined.

The chicks' reduced fear of humans elicited by regular physical handling persisted for at least 12 days after cessation of treatment (Jones & Waddington, 1993) but it is not yet known how durable the effects of the visual contact treatment might be. Neither has it been determined whether or not a regime of VC treatment would reduce the aversive properties of actual physical contact with humans, such as that encountered during capture and placement in a laboratory apparatus, manual harvesting of commercial broilers prior to slaughter, and cage depopulation of spent laying hens. Encouragingly though, a previous study showed that VC was accompanied by a numerical, albeit non-significant, reduction in the duration of chicks' tonic immobility fear reactions to manual restraint (Jones, 1993). Similarly, chicks whose primary source of visual stimulation during rearing was in the form of human caretakers also showed significantly shorter durations of tonic immobility than did those which had received no such visual contact with people (Eddy & Gallup, 1994).

Although the use of different batches precluded direct line comparisons, the present findings that avoidance scores were numerically greater in White Leghorns than in ISA Brown chicks (collective means = 52.75 versus 33.25) are consistent with previous reports of greater flightiness in White Leghorns than in medium-hybrid brown birds (Jones & Mills, 1983; Murphy & Duncan, 1977).

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ODORS, VOLATILES AND APPROACH-AVOIDANCE BEHAVIOR OF THE DOMESTIC CHICK (*GALLUS GALLUS* *DOMESTICUS*)

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ABSTRACT: Our aim was to determine whether the characteristics of an olfactory cue influenced the experience-dependent approach behavior observed in domestic chicks and to look at the effects of these odors on behavior in the home-cage. Chicks were reared individually with tubes containing an odor suspended in the home-cage. At day 4 post-hatching they were tested in a runway with visually identical test stimuli suspended at either end; one of these contained the familiar odor and the other was unscented. Chicks reared with the odor of nesting-litter approached the familiar stimulus in preference to the unscented stimulus. Chicks reared with a garlic odor did not demonstrate a preference for either stimulus. A specific preference for the odor of nesting-litter was demonstrated by altering the visual, but not olfactory, cues of the stimuli. Thus, exposure to nesting-litter establishes a preference for this odor, but exposure to garlic odor has no such effect. The same chicks were given a choice test between nesting-litter and garlic on day 9 post-hatching. Only those chicks reared with garlic-scented stimuli demonstrated a preference; they approached the nesting-litter-scented stimulus. The response of chicks to the presentation of olfactory stimuli within the familiar rearing environment was also assessed. When odors were presented, chicks reared with an unscented stimulus demonstrated a decrease in pecking frequency and increased attention to the testing stimulus, indicated by pecks directed at the testing stimulus and circling activity. Thus, young chicks can detect odors (nesting-litter and garlic odor) and form an association with certain odors (nesting-litter and not garlic odor). The odor of nesting-litter may serve to keep the chick in the proximity of the nest during early post-hatching life.

INTRODUCTION

The ability of avian species to respond to olfactory stimuli was thought to be less well developed than that of mammals (Bang &

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Cobb, 1968). However, it is known that birds are not completely anosmic. They possess the anatomical structures required to perceive odors (Bang, 1971) and electrophysiological recordings from the olfactory bulb indicate that the olfactory system responds to odoriferous stimuli (Tucker, 1965). In their natural environment some species of birds are known to use olfaction to locate food, for example, the kiwi, *Apteryx australis* (Wenzel, 1972), the turkey vulture, *Cathartes aura* (Stager, 1967), a number of shearwaters and petrels (Grubb, 1972), the common raven, *Corvus corax* (Harriman & Berger, 1986) and the black-billed magpie, *Pica pica* (Snyder & Peterson, 1979). Starlings, *Sturnus vulgaris*, are able to discriminate between plant species by olfaction alone (Clark & Mason, 1987) and pigeons, *Columba livia*, use olfactory cues in orientation and homing (Waldvogel, 1987; Papi, 1990).

Although the domestic chick appears to have a poorly developed sense of smell, there is increasing evidence that olfactory cues can regulate behavior in this species (Jones & Black, 1979; Tolhurst & Vince, 1976; Turro, Porter & Pocard, 1994). Jones & Gentle (1985) conducted a series of experiments to determine whether female chicks showed a preference for a familiar olfactory stimulus when placed in a novel situation. The olfactory cues used included 'clean' home-box litter and also geranium- and orange-scented home-box litters. They found that when confronted with a novel situation chicks preferred a familiar odor and that this preference for familiarity was found with chicks reared with both artificial and naturally-occurring odors. Although odors such as orange oil are not artificial *per se*, they are pure odorants and this term is used to distinguish these types of odors from those that a chick would normally experience, such as the olfactory cues from nesting-litter, which is likely to provide a complex mixture of odors.

Chicks are able to learn about the characteristics of artificial olfactory cues, such as clove oil, when they are associated with a visual stimulus (Vallortigara & Andrew, 1994). When reared with a cylindrical container scented with clove oil, suspended in the home-cage, they develop a preference for the odor as demonstrated by their approach behavior on day 3. This could be a form of imprinting learning.

We were interested to know whether chicks form preferences for some odors rather than others. For example, the natural odor of the nest might serve as a more pertinent stimulus to the young chick than artificial odors. The young of many altricial mammalian species, such as rats and mice, are attracted to and will approach odors associated

with the nest and the mother (Leon, 1992). The same is likely to be the case for young chicks, although they remain in the nest and with the hen for a shorter length of time than altricial mammals. Therefore, we decided to investigate the approach behavior of chicks towards the olfactory cues from the nesting-litter of mature chickens and to contrast this to their response to the odor of garlic.

In the main, the olfactory stimuli used in previous experiments examining olfaction and olfactory influences on the behavior of chicks have been fruity or floral odors, such as orange or clove oil (Jones & Gentle, 1985; Vallortigara & Andrew, 1994). These odors are perceived by humans as pleasant and non-irritating (Doty, Shaman & Dann, 1984). The garlic odor was selected on the assumption that it was likely to be perceived as unpleasant, and possibly irritating, by the chick. It is known that some humans perceive garlic as unpleasant and irritating (Doty, et al., 1984), although this has not yet been established in other species.

In addition, we looked at the effects of these odors on behavior in the home-cage. Jones (1987) reported that 8-day-old chicks demonstrated an initial avoidance of chick starter mash that had been treated with 2 drops of orange oil. He postulated that chicks did not associate the odorant with the food but instead with the general surroundings. Thus, the initial avoidance observed in these chicks was thought to be due to a shift in attention from the food to the environment. Therefore, we were also interested to know how chicks would respond in their familiar rearing environment when they were presented with the odors used in this study.

METHOD

Animals and housing conditions

White leghorn x australorp chicks from two separate batches of eggs were used for this study. They were incubated and hatched in a light incubator (Multiplo, Australia) maintained at 37.5°C. Shortly after hatching, the chicks were taken from the incubator and housed individually in gray metal cages (21 x 21 x 31 cm) with clear perspex fronts. They were provided with warmth and illumination from 25 Watt globes and maintained under a 24 hr light schedule in a room with the temperature held between 29-32°C. Chick starter mash and water were available *ad libitum*. A clear plastic test tube (2 x 8 cm) containing odoriferous material wrapped in white cotton wool was

suspended on a fine piece of thread so that the base of the tube was approximately 3 cm above the floor of each cage. Nine narrow slits (2 x 10 mm) were made in the tubes to allow adequate dissipation of the odors.

Exposure to odors

Fifty chicks (22 males and 28 females, sex determined at the end of the experiments by inspection of the gonads) were randomly assigned to one of three treatment groups. The tubes used for the first group (17 chicks) contained cotton wool only (referred to as unscented). The tubes used for the second group (16 chicks) contained nesting-litter (approximately 0.5 g mixture of feathers and feces obtained from the nesting-litter of adult birds in a free-range poultry shed) wrapped in cotton wool and inserted into the tubes. The tubes for the third group (17 chicks) contained approximately 0.5 g commercially available crushed garlic mixture (a semi-solid mixture which also contained some non-volatile additives; to the experimenter the principle volatile chemicals in the mixture were detectable as that of garlic), also wrapped in the cotton wool. Although the volatile chemical substances from the garlic mixture were referred to as the "garlic odor" or the "garlic-scented stimulus", any irritating properties may not have been due solely to the olfactory components of garlic. This group of chicks was housed in a separate, although similar, room to prevent the chicks of the other two groups from being exposed to the garlic odor. The odoriferous material and cotton wool were replaced every 4 days.

Approach test

Chicks were tested individually at 4, 9 and 18 or 19 days of age. We were most interested in the chicks response during the first test, at 4 days of age. They were placed in the middle of a runway (120 x 21 x 31 cm), painted matt gray. For scoring purposes the floor was marked into a middle section of 60 cm and two end sections, each of 30 cm. Twenty-five Watt globes were placed at each end and over the centre of the runway. At each end of the runway the testing stimuli were suspended at the same level as they had been at in the home-cage.

During the test at 4 days of age, each chick was given a choice between the familiar rearing stimulus (exactly the same tube with which they had been reared) and an unscented stimulus. Chicks

reared with an unscented stimulus were thus tested with a choice between two unscented stimuli, and chicks reared with nesting-litter or garlic were tested with a choice between a scented and an unscented stimulus.

As previously mentioned the test at 4 days of age was the main approach test. In addition we tested the same chicks in similar tests at various ages, as well as observing them in the home-cage (pecking test). At 9 days of age they were tested with a choice between a garlic-scented stimulus and a stimulus with the odor of nesting-litter. All chicks were thus tested with a choice between two scented stimuli.

In the final approach test, on day 18 or 19, the olfactory stimuli were presented in a ball of cotton wool, in contrast to the familiar plastic test tube that contained the odor in cotton wool in the previous tests. The cotton wool balls were suspended with a fine piece of thread at approximately 8 cm above the floor. Chicks reared with a garlic-scented stimulus were tested with a garlic-scented stimulus and an unscented stimulus. Chicks reared with a nesting-litter stimulus were tested with a nesting-litter stimulus and an unscented stimulus. In addition, chicks reared with an unscented stimulus were tested with either a nesting-litter- or a garlic-scented stimulus and an unscented stimulus.

In all of the approach tests the ends of the runway in which the stimuli were placed were randomised to control for positional cues. When not being used in a test, the testing stimuli were suspended in a home-cage with starter mash on the floor and situated in the same room as the rearing room containing that particular odor. This procedure was used to control for any olfactory cues that may have been acquired from the starter mash or from the rearing room. All of the tests were carried out in a well ventilated room, separated from the rooms where the chicks were reared.

A video camera was used to monitor the chick's behavior during testing. The experimenter was in the room during testing but was not visible to the chick. Chicks were placed in the runway for 5 min and the following were recorded; the end section of the runway that the chick entered first (first entry), the latency to approach either end of the runway and the time spent in the middle and end sections of the runway. Odoriferous cues that may have been produced by a chick during the previous test were reduced by removing the paper-towelling on the floor of the runway and replacing it with fresh towel after each chick was tested. The tubes were kept in the runway only when a chick was being tested and the confounding effects of lingering odors were minimised by fanning a piece of paper over the

runway at regular intervals between tests.

Pecking test

The effect of the odors on pecking and other behaviors in the home-cage was tested from day 15 to day 19 post-hatching. Ten min prior to each test, food, water and the rearing stimulus were removed from the home-cage and fresh paper-towelling was placed on the floor. The test began when 5 g of starter mash was spread on the floor and the testing stimulus was placed in the home-cage. The testing stimuli used were the familiar stimulus (on day 15), a nesting-litter stimulus (on day 16), a garlic-scented stimulus (on day 17) and an unscented stimulus (on day 18). Stimuli were presented in this order to reduce any confounding effects of lingering odors in the testing room. The following behaviors were recorded over a 2-min period; number of pecks at the ground (pecking frequency) and number of pecks at the testing stimulus, number of preening bouts, proportion of time spent crouching and number of times a chick circled around the testing stimulus.

Statistical analysis

If a chick failed to leave the middle section of the runway after 5 min during the approach tests, its score was not included in the analysis for that test (day 4, $n = 6$; day 9, $n = 5$; day 18/19, $n = 8$). Of those that did leave the middle section of the runway, most entered only one section (day 4, $n = 37$; day 9, $n = 36$; day 18/19, $n = 36$), although all chicks moved freely around the middle section of the runway. Thus, the data had a non-parametric distribution. The scores for first entry for each of the treatment groups were compared using the Binomial test (two-tailed). Wilcoxon matched-pairs signed-ranks tests, two-tailed, were used to analyse the latency to enter and the time spent in each end section of the runway (Gravetter & Wallnau, 1988; Siegel, 1956).

The pecking frequency scores were parametric and, therefore, analysed using a repeated-measures ANOVA. If this test yielded a significant result, *post hoc* Fisher's tests were used to analyse differences (Gravetter & Wallnau, 1988). The other behavior patterns assumed a non-parametric distribution and the scores were analysed using non-parametric statistics. Differences within each treatment group were analysed using the Friedman test. If this test yielded a significant result, *post hoc* Wilcoxon matched-pairs signed-ranks tests

were used to analyse differences (Siegel, 1956).

RESULTS

Approach test: Preference for familiar odor

The first entry of chicks reared with nesting-litter and tested at day 4 post-hatching was preferentially into the section of the runway containing the familiar-scented stimulus (first entry 'familiar section' = 11 chicks, $n = 14$, $p < 0.05$, Binomial test). Based on first entry, chicks reared with either an unscented stimulus (first entry 'familiar section' = 8 chicks, $n = 15$, $p > 0.10$) or with a garlic-scented stimulus (first entry 'familiar section' = 9 chicks, $n = 14$, $p > 0.10$) did not demonstrate a preference for either end of the runway.

Chicks reared with nesting-litter had a significantly shorter latency to approach the familiar-scented stimulus than the unscented stimulus (unscented = 258.9 ± 22.2 sec; familiar = 103.6 ± 26.0 sec; Wilcoxon test, $T = 9.0$, $p < 0.01$). No significant differences were found in the latency to approach either of the end sections of the runway in chicks that had been reared with either an unscented (unscented = 182.4 ± 34.0 sec; familiar = 204.9 ± 29.4 sec; $T = 52.5$, $p > 0.10$) or a garlic-scented stimulus (unscented = 198.4 ± 33.4 sec; familiar = 127.9 ± 36.0 sec; $T = 46.0$, $p > 0.10$).

Figure 1(a) depicts the amount of time chicks from each of the three treatment groups spent in the end sections of the runway. Chicks reared with nesting-litter spent more time in the section of the runway containing the familiar-scented stimulus compared to the amount of time spent in the section of the runway containing the unscented stimulus ($T = 8.0$, $p < 0.01$). No preference, indicated by the time spent in either of the end sections of the runway, was found in chicks reared with either an unscented ($T = 52.5$, $p > 0.10$) or a garlic-scented stimulus ($T = 31.0$, $p > 0.10$).

Approach test: A choice between two odors

The chicks reared with garlic entered the nesting-litter section first (nesting-litter section = 13 chicks, $n = 16$, $p < 0.05$, Binomial test) and took significantly longer to approach the garlic-scented stimulus than they did to approach the nesting-litter stimulus (garlic = 237.0 ± 29.5 sec; nesting-litter = 45.8 ± 18.5 sec; Wilcoxon test, $T = 8.0$, $p < 0.01$). No significant differences were found for first entry and

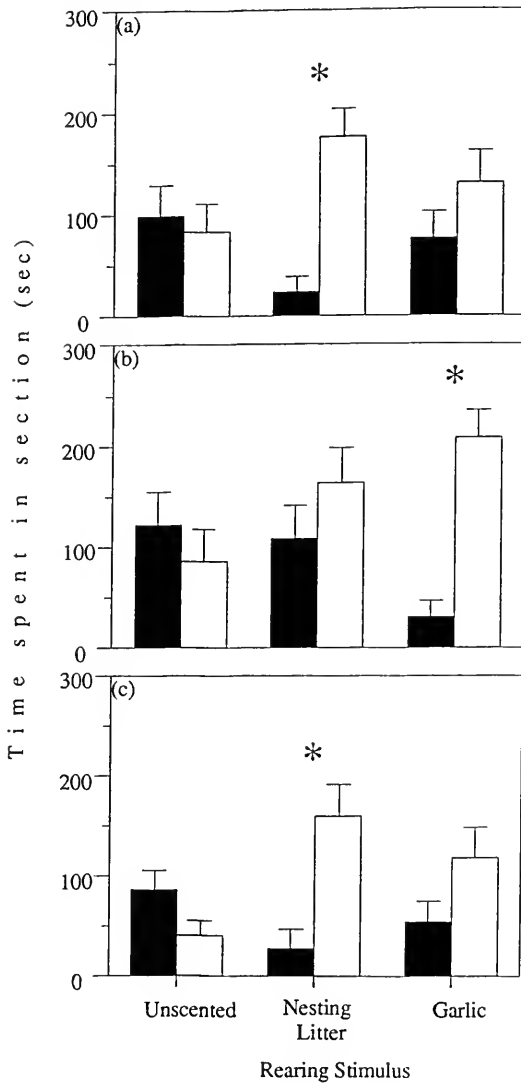


Figure 1. Mean time (\pm SE, sec) spent in the end sections of the runway. (a) Tested at 4 days of age with an unscented stimulus (■) and the familiar-scented stimulus (□). (b) Tested at 9 days of age between a garlic-scented stimulus (■) and a nesting-litter-scented stimulus (□). (c) Tested at 18 or 19 days of age with visually altered stimuli that were either unscented (■) or contained odor (□: Chicks reared with unscented stimuli were presented with either garlic-scented or nesting-litter-scented stimuli; those reared with the odor of garlic or nesting-litter were presented with their familiar odor). Chicks were reared with either an unscented, a nesting-litter-scented or a garlic-scented stimulus. * $p < 0.05$, Wilcoxon matched-pairs signed-ranks test, two-tailed.

the latency to approach each of the end sections of the runway by the chicks that had been reared with either an unscented (first entry nesting-litter section = 5 chicks, $n = 13$, $p > 0.10$; garlic = 116.8 ± 39.0 sec; nesting-litter = 164.8 ± 42.1 sec; $T = 43.0$, $p > 0.10$) or a nesting-litter stimulus (first entry nesting-litter section = 9 chicks, $n = 15$, $p > 0.10$; garlic = 157.5 ± 36.3 sec; nesting-litter = 94.9 ± 33.5 sec; $T = 44.0$, $p > 0.10$).

Chicks reared with garlic spent more time in the nesting-litter section of the runway than in the garlic-scented section of the runway ($T = 9.5$, $p < 0.01$). No preference, indicated by the time spent in either of the end sections of the runway, was found in chicks reared with either an unscented or a nesting-litter stimulus (unscented, $T = 44.0$, $p > 0.50$; nesting-litter, $T = 43.0$, $p > 0.10$). These results are presented in Figure 1(b).

Approach test: Altered visual cues

Figure 1(c) presents the results for the time spent in each section of the runway when chicks were tested with visually altered stimuli. Chicks reared with a garlic-scented stimulus showed an initial preference for the familiar-scented, although visually altered, stimulus over an unscented stimulus. They entered the garlic-scented section first (garlic section = 11 chicks, $n = 15$, $p < 0.05$, Binomial test) and had a longer latency to enter the unscented section compared to the familiar-scented section of the runway (unscented = 215.1 ± 29.0 sec; garlic = 88.8 ± 29.4 sec; Wilcoxon test, $T = 19.0$, $p < 0.05$). This was despite the fact that these chicks spent a statistically equal amount of time in both ends of the runway during the 5 min test period ($T = 32.0$, $p > 0.10$). When tested with an unscented stimulus and either a garlic or a nesting-litter stimulus, chicks reared with unscented stimuli did not demonstrate a preference. This was indicated by first entry (unscented section = 7 chicks, $n = 13$, $p > 0.50$), chicks latency to enter (unscented = 107.8 ± 32.5 sec; scented = 137.4 ± 33.6 sec; $T = 32.0$, $p > 0.10$) and the time spent in either of the end sections of the runway ($T = 27.0$, $p = 0.10$).

Chicks reared with nesting-litter demonstrated a preference for the familiar-scented section of the runway. This finding was based on first entry (nesting-litter section = 11 chicks, $n = 13$, $p < 0.01$), latency to approach either end of the runway (unscented = 250.2 ± 29.0 sec; nesting-litter = 98.4 ± 29.0 sec; $T = 12.5$, $p < 0.05$), and also by the time spent in each of the end sections of the runway ($T = 9.5$, $p < 0.05$).

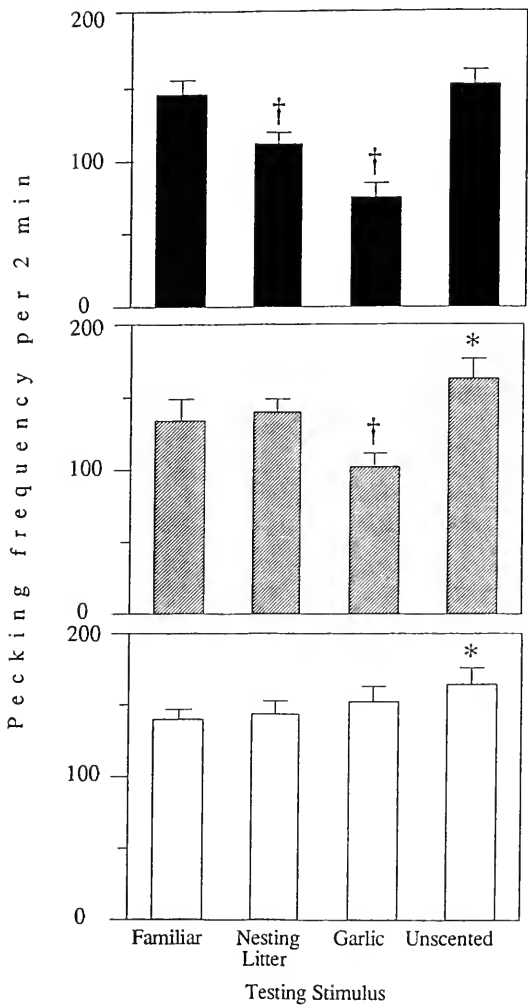


Figure 2. Mean pecking frequency (\pm SE) during four separate 2 min observations in the home-cage for chicks reared with unscented (■), nesting-litter-scented (gray bars) and garlic-scented stimuli (□). Symbols indicate a significant increase (*) or decrease (†) in the number of pecks compared to the initial test with the familiar-scented stimulus, $p < 0.05$, *post hoc* Fisher's test.

Pecking test

A repeated measures ANOVA demonstrated that there was a significant effect of the testing stimulus on the pecking frequency of chicks reared in the three treatment groups (group, $F(2, 47) = 3.1$, $p = 0.055$; stimulus, $F(3, 141) = 22.63$, $p < 0.001$; group \times stimulus, $F(6, 141) = 6.52$, $p < 0.001$). *Post hoc* analysis revealed that chicks reared with either an unscented or a nesting-litter-scented stimulus decreased their pecking frequency when presented with the garlic odor, while only those reared with an unscented stimulus demonstrated a reduction in pecking frequency when presented with a nesting-litter stimulus (see Figure 2). Moreover, when chicks that had been reared with a scented stimulus, either garlic or nesting-litter odor, were presented with an unscented stimulus they demonstrated an increase in pecking frequency.

There was an effect of the testing stimulus on the circling activity of chicks reared with an unscented (mean number of complete circles of familiar stimulus = 0.14 ± 0.10 ; nesting-litter = 1.0 ± 0.23 ; garlic = 0.86 ± 0.23 ; unscented = 0.40 ± 0.20 ; Friedman test, $\chi^2 = 8.6$, $p < 0.05$) or a nesting-litter stimulus (familiar = 0.21 ± 0.11 ; nesting-litter = 0.12 ± 0.08 ; garlic = 0.79 ± 0.16 ; unscented = 0.21 ± 0.16 ; $\chi^2 = 9.7$, $p < 0.05$) but not for those reared with a garlic-scented stimulus (familiar = 0.24 ± 0.14 ; nesting-litter = 0.40 ± 0.15 ; garlic = 0.30 ± 0.14 ; unscented = 0.29 ± 0.19). *Post hoc* analysis indicated that either the garlic ($p < 0.01$, Wilcoxon test) or the nesting-litter odor ($p < 0.05$) increased the circling activity of chicks reared with an unscented stimulus; those reared with a nesting-litter stimulus increased their circling activity only when presented with the garlic odor ($p < 0.05$). There was also an increase in the number of pecks directed at the garlic-scented stimulus ($p < 0.05$) by chicks reared with an unscented stimulus (familiar = 0.07 ± 0.07 ; nesting-litter = 0.29 ± 0.13 ; garlic = 0.64 ± 0.13 ; unscented = 0.07 ± 0.07 ; $\chi^2 = 8.4$, $p < 0.05$). The remaining data for the number of pecks directed at the testing stimulus (not including the unscented group), the number of preening bouts and the proportion of time spent crouching were not significantly greater than 0 (no response).

DISCUSSION

When tested at 4 days of age, chicks reared with the odor of nesting-litter preferred to approach a stimulus scented with this odor

in preference to an unscented stimulus. The chicks reared with a garlic-scented stimulus did not show a preference for the familiar-rearing odor when tested at 4 days of age. Thus, the chicks demonstrated a differential response to the odors used in this study, developing a preference for nesting-litter and not garlic.

The pecking test revealed that chicks reared with unscented stimuli altered their pecking behavior in the presence of both nesting-litter- and garlic-scented stimuli, indicating that they were able to detect the odors at the concentrations used in this experiment. Therefore, chicks reared with garlic-scented stimuli must have been able to detect the garlic odor as presented. The irritating properties of garlic may explain why the chicks did not develop a preference for it.

Since most of the chicks tended to enter only one section of the runway, it appeared that they were able to make a choice between the two stimuli when they were in the middle section of the runway. The middle section was 60 cm long and chicks moved freely within this part of the runway. The fact that those raised with nesting-litter odor demonstrated a preference to approach this odor indicates that they were able to sample both stimuli when in the middle section and then make a choice before leaving this section. In addition, it is unlikely that the chicks were able to choose between the two stimuli on the basis of specific visual cues or odors produced by the chicks' which were associated with the rearing stimulus, as chicks reared with an unscented stimulus showed no preference for their familiar tube over a similar unscented tube. Also, when chicks reared with nesting-litter were tested with stimuli that were visually altered into a ball shape on day 19, they still showed a preference for the familiar-scented stimulus over the unscented stimulus. Thus, they responded to the odors present in the testing stimulus rather than to the visual cues.

When chicks reared with a garlic-scented stimulus were tested with visually altered stimuli in the runway at 18 days of age, they approached the familiar garlic-scented stimulus before they approached the unscented stimulus. This indicated that they could detect the garlic odor. However, even in this case, the amount of time that this group of chicks spent in either of the end sections of the runway did not differ significantly. Thus, prolonged exposure to garlic-scented stimuli altered their approach behavior but they did not develop a preference for the garlic odor. When chicks reared with an unscented stimulus, and tested on day 18 or 19 with visually altered stimuli, were given a choice between unscented and garlic-scented stimuli or unscented and nesting-litter-scented stimuli, they did not demonstrate a preference for either stimulus. This contrasts to the

response of chicks reared with nesting-litter which, as mentioned above, chose to approach the nesting-litter odor over an unscented stimulus in the same task. If the chicks raised with unscented stimuli had behaved similarly, they would have preferentially approached the unscented stimulus. It is unlikely that those reared with unscented stimuli were unable to discriminate the odors of garlic or nesting-litter from the unscented stimulus but they may have responded to the visual novelty of the altered stimuli, which were at both ends of the runway, rather than to the odors of garlic or nesting-litter.

In the natural environment choices are often made between two scented stimuli, and we tested this on day 9. Chicks reared with garlic and given a choice of garlic-scented and nesting-litter-scented stimuli demonstrated a preference for the nesting-litter stimulus. Either this group of chicks preferentially approached the nesting-litter stimulus or they demonstrated aversion to their familiar-scented stimulus (garlic). However, when tested with a choice between a garlic-scented and an unscented stimulus at 4 days of age, this group of chicks did not avoid the garlic-scented stimulus. Therefore, it seems that they actively chose to approach the nesting-litter rather than being repelled by volatiles from the garlic-scented stimulus. It is possible that they were predisposed to approach the nesting-litter odor but, given that these chicks had previous experience in the runway, it is not possible to be certain of this conclusion. Moreover, chicks reared with unscented stimuli did not demonstrate a preference for either the garlic-scented or the nesting-litter-scented stimulus. Unexpectedly, those reared with nesting-litter-scented stimuli also did not demonstrate a preference for nesting-litter over garlic, even though they demonstrated a preference for the nesting-litter odor on day 4 and also on day 19 when the stimuli were visually altered. We recognise that the results from the approach tests carried out on day 9, and days 18 and 19, were potentially influenced by repeated testing, as well as the age of the chicks. The results do, however, indicate that chicks are more likely to approach nesting-litter-scented stimuli rather than garlic-scented stimuli.

We also observed the responses of chicks to odors presented in the home-cage. Despite the potential effects of being tested over four consecutive days, there were no statistically significant differences in the behavior of chicks reared with an unscented stimulus when they were tested with an unscented stimulus on days 15 and 18. By contrast, chicks reared with either nesting-litter or garlic-scented stimuli showed an increase in pecking frequency when presented with an unscented stimulus compared to the familiar-scented stimulus.

Since all chicks pecked at the same rate when presented with the familiar-scented stimulus, this might indicate that chicks reared with an "odor" detected general changes in their olfactory environment.

This result is supported by the findings of Jones (1987) who found that 8-day-old chicks trained to eat water-treated food and tested with food treated with orange oil were able to detect changes in their olfactory environment, indicated by an initial avoidance of the "unfamiliar" food. Moreover, he found that chicks trained to eat orange oil-treated food readily accepted water-treated food. Since these chicks responded similarly to both orange oil- and water-treated food it was thought that 7 days of exposure to food treated with orange oil was not long enough for them to associate the food with the odor and, therefore, to detect the odor's absence. The current results indicate that two weeks was sufficient for chicks reared with an odor to form an association between the food and the rearing odor, and they were able to detect the absence of the familiar odor.

The results from the pecking test indicate clearly that chicks reared with an unscented stimulus were able to detect the odors as presented. When the odor was presented, there was a decrease in their pecking at food and increased attention to the testing stimulus, indicated by pecks directed at the testing stimulus and circling activity. Although chicks reared with a nesting-litter stimulus showed a similar change in behavior on the presentation of a garlic-scented stimulus, those reared with a garlic-scented stimulus were not affected by the presentation of a nesting-litter stimulus. A change in behavior may have been due to aversive properties of the odors or simply due to increased sensitivity to odors.

Perception of the odors used in this study is likely to have occurred as a result of stimulation of the olfactory system, but it is not possible to exclude the involvement of the trigeminal system. Trigeminal chemoreception is present in at least some species of birds (Mason & Silver, 1983) and is known to detect chemical irritants. It is possible that the trigeminal route is important in the chick's perception of volatile chemical substances, including the odors from nesting-litter and particularly those from garlic.

Chicks are able to form a preference for an artificial odor such as orange or clove oil (Jones & Gentle, 1985; Vallortigara & Andrew, 1994). However, nesting-litter provides a mixture of odors, any or all of which they may detect and respond to as patterned olfactory information. The specific odors in nesting-litter that may be important for the chicks response, as yet, remain unknown. Jones and Faure (1982) reported that 9-day-old chicks show a preference for

familiar litter in an otherwise unfamiliar environment, and this was thought to be due to the odors associated with their feces. Chicks remain close to the nest and the hen until they are about 4 to 6 days of age (Workman & Andrew, 1989). During this period the odors from nesting-litter may provide important cues for the young chick to learn about the nest site and the hen, potentially a form of olfactory imprinting. A number of studies suggest that under natural conditions visual imprinting does not occur until the young bird leaves the nest (Dyer, Lickliter & Gottlieb, 1989; Workman & Andrew, 1989). Thus, olfactory learning ('imprinting') together with auditory learning (Fält, 1981) may precede visual imprinting.

As the chicks in this study did not develop a preference for garlic odor during the first week of life, the particular characteristics of an odor (this may be due in part to the relative concentration of a particular odor) appeared to influence the development of a preference and the approach behavior. There may even be a predisposition for nesting-litter, as has been described for the visual characteristics of the hen (Bolhuis, 1991). This predisposition for the natural odor might emerge around the time of hatching and it may serve to keep the chick in the proximity of the nest and the hen.

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BOOK REVIEW

R. Bryan Jones
Roslin Institute, Edinburgh

The Development of Brain and Behaviour in the Chicken, by Lesley J. Rogers. CAB International, Wallingford, U.K., 1995, 288 pp. £45 (US\$77.50)*.

This is a timely and valuable book which provides an accessible, scholarly and thorough account of research in the complex area of brain and behaviour development in the chicken. It also serves to deliver a number of important take-home messages. Firstly, for example, by juxtaposing behavioural and neurobiological research in the chicken with that in other birds and in mammals, it clearly demonstrates the value of the domestic chick as a model animal. Secondly, by highlighting the complex interactions between environmental, experiential, genetic and hormonal factors in the developing chick it illustrates the benefits of a multi-disciplinary approach. Thirdly, it identifies some of the welfare problems faced by chickens and presents a compelling argument that increased understanding of their cognitive abilities is crucial for an informed improvement of wellbeing and performance.

Chapter 1 discusses the development of brain and behaviour in the embryo. It is packed with important information and it will undoubtedly be required reading for all those interested in the time course of developmental changes in the sensory and endocrine systems as well as in general pre-hatch behaviour. The chronological chart (Table 1.1.) is particularly useful. Like the rest of the chapter, the information is presented in such a way as to be easily assimilated, even by someone with only a rudimentary knowledge of the central nervous system. By presenting several cases of seemingly

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inconsistent data, Professor Rogers also rightly sounds a cautionary note in pointing out that stimulus saliency and the type of measurement made are often influential variables.

Chapter 2 describes some the primary external variables (e.g. light, sound, touch) influencing embryonic development, their interaction with internal factors (such as the circulating levels of sex hormones), the role of communication with the hen and between embryos, and the important intermodality effects of sensory stimulation. Attention is also drawn to the possible effects of olfactory stimulation and of variations in atmospheric pressure.

The many variables influencing early learning and the development of selected behavioural systems are described in Chapter 3. Firstly, it covers imprinting, both filial and sexual, and reviews the evidence for the emergence of predispositions and for the existence of sensitive periods. This section also discusses social recognition and the formation of social attachments. The appearance of fear behaviour is then discussed in terms of maturation, imprinting and the recognition of novelty, early experience, and the social condition. The next section reviews the visual, olfactory and gustatory mechanisms involved in recognizing food and learning to feed as well as in the development of food preferences. Rogers then disputes early claims that rank order does not develop until chicks are several weeks old. By assessing intergroup competition for desirable resources rather than using the more traditional measure of aggressive pecking, she shows that social hierarchies exist even in the first week of life. Data on sleep and on cycles of behaviour are presented in the closing sections.

An intriguing and scholarly account of the development of the brain after hatching is presented in Chapter 4. It describes: the asymmetrical development of the forebrain hemispheres and the different behaviours controlled by each hemisphere; neurochemistry and neural plasticity; the cellular and molecular correlates of imprinting and memory formation; the routes of communication between the two hemispheres; and the maturation of synapses.

Chapter 5 discusses the behavioural transitions that occur during the first two or three weeks after hatching in terms of shifting hemispheric dominance. Some of the behaviour systems covered include: Thermoregulation, exploration, fear, feeding, attention, attack and copulation. This chapter also makes the important points that hemispheric dominance is sensitive to differences in age, gender and environmental context.

There is something of interest for all readers in Chapter 6 but it

will be particularly useful for comparative psychologists and physiologists. It begins by reminding us that although altricial species hatch at a more immature stage than precocial ones, like the chick, they follow the same general programme of development. It goes on to discuss species differences in the size of various brain structures and to relate this to their lifestyles. Parallels as well as distinctions are then drawn between hemispheric lateralization and behavioural function in a number of avian and mammalian species. Rogers closes with a compelling argument that the development of lateralization in the brain reflects multifactorial rather than unitary influences.

The seventh and final chapter reviews recent research on the cognitive abilities of birds and poses the intriguing and hugely important question "Can a brain be domesticated?" It addresses this question in terms of the chicken's long history of domestication and the demands placed upon it by the environmental and economic constraints of intensive farming systems. I would personally have enjoyed seeing an expanded chapter which placed greater emphasis on relating the wealth of information presented earlier to specific issues of poultry welfare and productivity. However, I accept that this may not be the most appropriate forum. Furthermore, Rogers does reach the telling and thought-provoking conclusion that even vastly improved intensive systems are unlikely to meet the cognitive demands of the hitherto underestimated chicken brain.

In conclusion, this is a handsome and well produced book; the quality of print, photographs and line drawings is excellent. The style of writing, the provision of summaries and concluding remarks for each chapter, and the frequent use of subheadings make the contents easy to follow and digest, despite the complexity of the subject. It will be a valuable addition to the shelves of researchers, teachers and students of animal behaviour, neurobiology, comparative and experimental psychology, poultry science, and animal welfare. Furthermore, not only is the book affordable but it also represents extremely good value for money. I enjoyed it immensely, I expect to dip into it frequently and I cannot recommend it too highly.

BEATRIX (TRIXIE) GARDNER - A TRIBUTE

Roger S. Fouts

Central Washington University, USA

Beatrix (Trixie) Gardner died suddenly on June 5, 1995, in Padua, Italy, while on a European lecture tour. The world has lost a great scientist and chimpanzees have lost a great friend and advocate.

Beatrix Gardner earned her B.A. from Radcliffe, her M.S. from Brown University, and her D.Phil. from Oxford University studying with the Nobel Laureate, Niko Tinbergen. From 1959-1963 she served on the faculty of Wellesley College. In 1963 she and her husband Allen joined the faculty of the University of Nevada at Reno. While at Oxford University she was the recipient of an NSF Fellowship. She was also the recipient of the NIMH Research Scientist Development Award for ten years from 1967 to 1977.

Trixie and Allen are best known for the innovation of teaching sign language to cross-fostered chimpanzees which began with Project Washoe in 1966. The Gardners replicated and extended Project Washoe with four other chimpanzees, Moja, Pili, Tatu, and Dar who lived like human children from birth. From a scientific standpoint the replication and extension is more significant than the initial discovery. Later, in the Fouts laboratory the infant chimpanzee Loulis learned over 50 signs of ASL that he could only have learned from his adopted mother, Washoe, and three other chimpanzees cross-fostered by the Gardners.

Scholarly journals and books in psychology, biology, anthropology, philosophy and linguistics as well as popular articles, books, and films have featured the work of the Gardners. Perhaps, the clearest testimonial to the significance of this landmark achievement is the storm of controversy that it continues to evoke.

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So far the Gardners have only reported the main outlines of the vast record of their five experimental subjects running to 35,000 pages of handwritten notes and many hours of film and video tape. The analysis and reporting of the complete record dominated their lives in recent years and this is the work that Allen Gardner and his students must now carry on.

Beatrix Gardner was a great scientist who was devoted to rigorous observation and faithful reporting. She was also a genial, gentle, dignified, and terribly modest human being and a truly caring and nurturing mentor who left an indelible mark on students. She always taught them to see and report what chimpanzees and children actually do and to be suspicious of what grand theoreticians say they should do. Her motto was to let the chimpanzees and the children speak for themselves.

The University of Nevada, Reno, established the somewhat generically named:

UNR Primate Research Fund
c/o UNR Foundation
University of Nevada
Reno, NV 89557

to receive donations in Trixie's memory. The money will be used to support the students.

Announcement

7TH MEETING OF THE INTERNATIONAL SOCIETY FOR COMPARATIVE PSYCHOLOGY

**Concordia University, 1455 De Maisonnueve Blvd. West
Montreal, Quebec, Canada H3G 1M8**

The 7th Biennial Meeting of the ISCP will be held at Concordia University from August 14-16, 1996 immediately prior to the International Congress of Psychology (ICP).

Accommodation has been arranged at the Chateau Versailles, an excellent hotel located centrally in downtown Montreal and walking distance from the Metro (subway) station. The rate for participants in the 7th Meeting of the ISCP is below that for comparable hotels on the International Congress list, and these same low rates may be maintained throughout the entire ICP meeting. Please register early for your accommodation since there are only a limited number of rooms held for the ISCP.

The deadline for registration for the ISCP Meeting is April 15, 1996. Registration forms are available from the ISCP Conference Coordinator.

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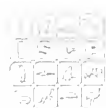
All manuscripts are reviewed by two readers other than the Editors. Authors should send three copies of their manuscripts to the Editor (Hughes). One diskette copy saved in ASCII format or as a standard word processor file, will subsequently need to be submitted to the Editor once the manuscript is accepted for publication. Indicate clearly on the diskette the author(s) name(s), file format and program version number. (Alternate arrangements may be possible for those authors who are unable to provide a diskette copy).

The manuscript should have a cover page with the full title, the author(s) name(s) and address(es) and should indicate the person with whom the Journal may correspond. If the author(s) has(ve) an electronic mail address or fax number, these should be given in a cover letter accompanying the manuscript. The abstract should be on a separate page. All articles are published in English; the author(s) should also submit an abstract in their language if it does not require non-Roman type. Author(s) are responsible for the accuracy of the non-English abstract. Acknowledgements should appear on a separate page and carry the title of the article and the author(s) name(s). If the author(s) prefer(s) anonymity in the review process, this should be stated in a covering letter and the manuscript, abstracts, and illustrative material should carry only the title of the article. The cover sheet and acknowledgements will not be sent to the reviewers in this instance.

GENERAL REQUIREMENTS: Logical organization is essential. While headings help to structure the content, titles and headings within the manuscript should be as short as possible. Tables and figures should not be redundant. Illustrative material should be self-explanatory and used sparingly. Tables and figures must be in camera-ready condition and include separate captions. Only items cited in manuscripts should be listed as references. Page numbers must be provided for direct quotations. Footnotes should not be used except in special circumstances and with permission of the Editor.

MANUSCRIPTS should be double-spaced, the original on white bond paper, with margins of 3 cm on all four edges and approximately 26 lines to the page. Manuscripts longer than 20 typed pages (not counting figures, tables, and references) will only be considered in unusual circumstances. The style manual of the American Psychological Association (3rd Edition, 1983) is to be followed. Manuscripts which do not meet the style requirements will be returned for retyping.

REFERENCES should be listed on a separate page and referred to in the text by author(s) and year of publication as in the Publication Manual of the American Psychological Association.



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